TITLE OF THE INVENTION

HERMETIC COMPRESSOR

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of Korean Patent Application No. 2003-85710, filed November 28, 2003 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates, in general, to hermetic compressors and, more particularly, to a hermetic compressor which has an improved oil feed structure to efficiently feed lubricating oil using a rotating force of a rotating shaft to a plurality of drive parts.

Description of the Related Art

As an example of conventional techniques of hermetic compressors, Japanese Patent Laid-open Publication No. 2000-205130 discloses a hermetic compressor having an oil feed unit to feed lubricating oil using a rotating force of a rotating shaft to a plurality of drive parts. The oil feed unit of the above-mentioned hermetic compressor has an oil piece, a main oil feed path and a spiral oil feed groove, thus forcing the lubricating oil upward from a bottom of a hermetic casing to the drive parts. The oil piece of the conventional oil feed unit is provided on a lower end of the rotating shaft, while the main oil feed path extends upward in the rotating shaft above the oil piece while being eccentric from a central axis of the

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rotating shaft. The spiral oil feed groove is provided around an outer surface of the rotating shaft at a portion above an upper end of the main oil feed path so that the spiral oil feed groove communicates with the main oil feed path. The conventional oil feed unit further includes an upper oil feed path to feed the lubricating oil to a piston of a compression unit of the hermetic compressor. The upper oil feed path is provided in an eccentric part which is provided on an upper end of the rotating shaft, so that the upper oil feed path communicates with an upper end of the spiral oil feed groove.

During an operation of the conventional hermetic compressor, the rotating shaft rotates and the lubricating oil is lifted upward from the bottom of the hermetic casing by the oil piece. Thus, the lubricating oil is fed to the spiral oil feed groove via the eccentric main oil feed path. Thereafter, the lubricating oil flows upward along the spiral oil feed groove to the upper oil feed path of the eccentric part. While the oil flows upward along the spiral oil feed groove as described above, the oil lubricates and cools a junction between the outer surface of the rotating shaft and an inner surface of a shaft support part which supports the rotating shaft. The oil is, thereafter, fed from the upper oil feed path to the piston of the compression unit, thus lubricating the piston.

However, the conventional hermetic compressor having the above-mentioned oil feed unit is problematic as follows. Because the main oil feed path linearly and longitudinally extends in the rotating shaft while being in parallel to the central axis of the rotating shaft, a force which lifts the oil in the main oil feed path is reduced during a low speed rotation of the rotating shaft. In the

above state, the main oil feed path may fail to feed a sufficient amount of lubricating oil to the spiral oil feed groove.

Furthermore, the upper oil feed path linearly extends upward in the eccentric part of the rotating shaft while being in parallel to the central axis of the rotating shaft, the oil lift force in the upper oil feed path may be reduced, so that the conventional oil feed unit of the hermetic compressor may fail to feed a sufficient amount of lubricating oil to the piston of the compression unit.

SUMMARY OF THE INVENTION

Accordingly, it is an aspect of the present invention to provide a hermetic compressor, which has an improved oil feed structure to generate a sufficient force which lifts oil upward even when a rotating shaft rotates at a low speed, thus efficiently feeding a sufficient amount of lubricating oil to a plurality of drive parts.

Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

The above and/or other aspects are achieved by providing a hermetic compressor, including: a hermetic casing; a frame provided in the hermetic casing; a drive unit provided in a lower portion of the frame; a compression unit provided on an upper portion of the frame; a rotating shaft vertically installed in the frame to transmit a rotating force of the drive unit to the compression unit, with an eccentric part provided on an upper end of the rotating shaft and coupled to the compression unit; and an oil feed unit provided on the

rotating shaft to feed oil from a bottom of the hermetic casing to a plurality of drive parts, the oil feed unit including: a first oil pickup unit provided on a lower end of the rotating shaft to lift the oil upward from the bottom of the hermetic casing; a first oil feed path provided in the rotating shaft above the first oil pickup unit while being eccentric from a central axis of the rotating shaft; a spiral oil feed groove provided around an outer surface of the rotating shaft above the first oil feed path and communicating with the first oil feed path; a second oil feed path provided in the eccentric part of the rotating shaft and communicating with the spiral oil feed groove; and a second oil pickup unit provided in the first oil feed path to increase an oil lift force.

The first oil feed path may be inclinedly provided in the rotating shaft so that a central axis of the first oil feed path is diverged from the central axis of the rotating shaft in a direction from the lower end to the upper end of the rotating shaft.

The second oil feed path may be inclinedly provided in the eccentric part of the rotating shaft so that a central axis of the second oil feed path is diverged from the central axis of the rotating shaft in a direction from a lower end to an upper end of the eccentric part.

The hermetic compressor may further include: a bearing provided between the upper portion of the frame and a lower end of the eccentric part of the rotating shaft, wherein the second oil feed path may extend from the eccentric part of the rotating shaft to a predetermined position of an interior of the rotating shaft under the bearing and communicates with the spiral oil feed groove via a communication hole which is provided on the rotating shaft in a radial direction.

The bearing may be a thrust bearing to support an axial load.

The hermetic compressor may further include: an oil guide part provided on the outer surface of the rotating shaft so that the oil guide part extends from an upper end of the spiral oil feed groove to a position of the bearing, thus feeding the oil to the bearing.

The oil guide part may be a flat surface which is provided on the outer surface of the rotating shaft in an axial direction.

The first oil pickup unit may include: an oil guide body having a cylindrical shape and provided with an oil inlet at a lower end of the oil guide body, the oil inlet of the oil guide body having an inner diameter which is smaller than an outer diameter of the oil guide body; and a spiral blade provided in the oil guide body.

The second oil pickup unit may be a spiral blade provided in the first oil feed path.

The hermetic compressor may further include: an auxiliary oil feed path provided in the eccentric part of the rotating shaft in a radial direction to communicate with the second oil feed path.

The above and/or other aspects are achieved by providing a hermetic compressor, including: a hermetic casing; a frame provided in the hermetic casing; a drive unit provided in a lower portion of the frame; a compression unit provided on an upper portion of the frame; a rotating shaft vertically installed in the frame to transmit a rotating force of the drive unit to the compression unit, with an eccentric part provided on an upper end of the rotating shaft and coupled to the compression unit; and an oil feed unit provided on the rotating shaft to feed oil from a bottom of the hermetic

casing to a plurality of drive parts, the oil feed unit including: a first oil pickup unit provided on a lower end of the rotating shaft to lift the oil upward from the bottom of the hermetic casing; a first oil feed path provided in the rotating shaft above the first oil pickup unit while being eccentric from a central axis of the rotating shaft; a spiral oil feed groove provided around an outer surface of the rotating shaft above the first oil feed path and communicating with the first oil feed path; and a second oil feed path provided in the eccentric part of the rotating shaft and communicating with the spiral oil feed groove, the second oil feed path being inclined in the eccentric part so that a central axis of the second oil feed path is diverged from the central axis of the rotating shaft in a direction from a lower end to an upper end of the eccentric part.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the preferred embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a sectional view showing a construction of a hermetic compressor, according to an embodiment of the present invention;

FIG. 2 is a partially sectioned front view showing a construction of an oil feed unit provided on a rotating shaft of the hermetic compressor of FIG. 1;

FIG. 3 is a partially sectioned front view showing a construction of both a second oil feed path and an oil guide part provided on an upper portion of the rotating

shaft of FIG. 2; and

FIG. 4 is a sectional view taken along a line IV-IV' of FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the present preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

As shown in FIG. 1, the hermetic compressor according to the embodiment of the present invention has a hermetic casing 10, a frame 12 installed in the hermetic casing 10 while being supported by a plurality of damping units 11, a compression unit 20 provided on an upper portion of the frame 12, and a drive unit 30 provided in a lower portion of the frame 12 to drive the compression unit 20.

The hermetic compressor further includes a rotating shaft 40 which is vertically installed in the frame 12 while being supported by a shaft support part 13 of the frame 12 to rotate relative to the frame 12. The rotating shaft 40 transmits a rotating force of the drive unit 30 to the compression unit 20, with an eccentric part 41 provided on an upper end of the rotating shaft 40 to be eccentric from a central axis of the rotating shaft 40. The eccentric part 41 is coupled to the compression unit 20. The hermetic compressor further includes a bearing support unit 42 which is provided at a lower end of the eccentric part 41, with a diameter of the bearing support unit 42 being larger than an outer diameter of the rotating shaft 40 so that the bearing support unit 42 is supported on an

upper surface of the frame 12. The hermetic compressor further includes a thrust bearing 43 which is provided between the upper surface of the frame 12 and a lower surface of the bearing support unit 42 to support an axial load of the rotating shaft 40 and to allow for a smooth rotation of the rotating shaft 40.

The drive unit 30 of the hermetic compressor includes a rotor 31 which is axially fitted over the rotating shaft 40 to rotate along with the rotating shaft 40. The drive unit 30 further includes a stator 32 which is securely mounted around the rotor 31 to generate an electromagnetic field during an operation of the hermetic compressor. The compression unit 20 has a cylinder block 21 which defines a compression chamber therein to compress a refrigerant, with a cylinder head 22 mounted to an end of the cylinder block 21 to cover the compression chamber. The compression unit 20 further includes a piston 23 which is received in the compression chamber of the cylinder block 21 to compress the refrigerant while reciprocating within the compression chamber. The piston 23 of the compression unit 20 is connected to the eccentric part 41 of the rotating shaft 40 by a connecting rod 25. Thus, when the rotating shaft 40 rotates by an operation of the drive unit 30, an eccentric rotating motion of the eccentric part 41 is converted into a rectilinear reciprocating motion of the piston 23 by the connecting rod 25, so that the piston 23 rectilinearly reciprocates in the compression chamber to compress the refrigerant in the compression chamber.

The hermetic compressor of the present invention contains a predetermined amount of lubricating oil on a bottom of the hermetic casing 10 to lubricate and cool a plurality of drive parts of the hermetic compressor. The hermetic compressor of the present invention further

includes an oil feed unit which is provided on the rotating shaft 40 to feed the lubricating oil from the bottom of the hermetic casing 10 to the plurality of drive parts using the rotating force of the rotating shaft 40.

The oil feed unit of the present invention includes a first oil pickup unit 51, a first oil feed path 52, a spiral oil feed groove 54 and a second oil feed path 56, as shown in FIG. 2. The first oil pickup unit 51 is provided on the lower end of the rotating shaft 40, while the first oil feed path 52 is provided in the rotating shaft 40 above the first oil pickup unit 51. The spiral oil feed groove 54 is provided around the outer surface of the rotating shaft 40 above the first oil feed path 52 and communicates with the first oil feed path 52. The second oil feed path 56 is provided in the eccentric part 41 of the rotating shaft 40 and communicates with the spiral oil feed groove 54.

In a detailed description of the oil feed unit, the first oil pickup unit 51 includes an oil guide body 51a which is mounted at an upper end thereof to the lower end of the rotating shaft 40. The oil guide body 51a has a hollow cylindrical shape, with a diameter of the oil guide body 51a reduced in a direction from the upper end to a lower end thereof. The oil guide body 51a is immersed at the lower end thereof in the lubricating oil, with an oil inlet 51c provided at the lower end of the oil guide body 51a. The oil inlet 51c of the oil guide body 51a has an inner diameter which is smaller than an outer diameter of the lower end of the oil guide body 51a. The first oil pickup unit 51 further includes a spiral blade 51b which is provided in the oil guide body 51a. During a rotation of the rotating shaft 40, the lubricating oil which has been introduced into the lower portion of the first oil pickup

unit 51 through the oil inlet 51c is lifted upward along the spiral blade 51b to the first oil feed path 52 by a rotation of the spiral blade 51b.

The first oil feed path 52 to guide the oil upward in the rotating shaft 40 longitudinally extends in the rotating shaft 40 from a predetermined lower position above the upper end of the first oil pickup unit 51 to a predetermined upper position above a lower end of the shaft support part 13 of the frame 12 which supports the rotating shaft 40. The first oil feed path 52 is eccentric from the central axis of the rotating shaft 40, and is inclined in the rotating shaft 40 so that a central axis of the first oil feed path 52 is diverged from the central axis of the rotating shaft 40 in an upward direction at a predetermined angle θ_1. The first oil feed path 52 further includes a first communication hole 52a which is provided on the rotating shaft 40 in a radial direction at a position aligned with the upper end of the first oil feed path 52. Thus, the upper end of the first oil feed path 52 communicates with a lower end of the spiral oil feed groove 54 via the first communication hole 52a. The above-mentioned construction of the first oil feed path 52 increases a centrifugal force acting on the lubricating oil in the first oil feed path 52 during the rotation of the rotating shaft 40, thus the oil is efficiently lifted upward through the first oil feed path 52. The oil feed unit of the present invention further includes a second oil pickup unit 53 which is a spiral blade provided in the first oil feed path 52 to increase the oil lift force in the first oil feed path 52. During an operation of the hermetic compressor, the oil lift force in the first oil feed path 52 is increased by both an operation of the second oil pickup unit 53 and the centrifugal force acting

on the lubricating oil resulting from the rotation of the rotating shaft 40. Thus, the oil is efficiently lifted upward to the spiral oil feed groove 54 through the first oil feed path 52.

The spiral oil feed groove 54 is provided around the outer surface of the rotating shaft 40 to have a predetermined depth, so that an oil passage is defined between the outer surface of the rotating shaft 40 and the inner surface of the shaft support part 13 of the frame 12. Thus, the lubricating oil smoothly flows upward along the spiral oil feed groove 54 during the rotation of the rotating shaft 40. While the lubricating oil flows upward along the spiral oil feed groove 54, the oil lubricates and cools the junction between the outer surface of the rotating shaft 40 and the inner surface of the shaft support part 13.

The second oil feed path 56 is inclined in the eccentric part 41 of the rotating shaft 40 so that a central axis of the second oil feed path 56 is diverged from the central axis of the rotating shaft 40 in the upward direction at a predetermined angle θ_2. The second oil feed path 56 communicates, at a lower end thereof, with an upper end of the spiral oil feed groove 54 via a second communication hole 55 that is provided on the rotating shaft 40 in the radial direction. The second oil feed path 56 communicates, at an upper end thereof, with an upper surface of the eccentric part 41 of the rotating shaft 40. The above-mentioned construction of the second oil feed path 52 increases a centrifugal force acting on the lubricating oil in the second oil feed path 56 during the rotation of the rotating shaft 40. Thus, the lubricating oil is efficiently fed through the second oil feed path 56 from the upper end of the spiral oil feed groove 54 to the

compression unit 12 which is provided on the upper portion of the frame 12. The oil feed unit of the present invention further includes a second oil pickup unit 53 which is a spiral blade provided in the first oil feed path 52 to increase the oil lift force in the first oil feed path 52. During an operation of the hermetic compressor, the oil lift force in the first oil feed path 52 is increased by both an operation of the second oil pickup unit 53 and the centrifugal force acting on the lubricating oil resulting from the rotation of the rotating shaft 40. Thus, the oil is efficiently lifted upward to the spiral oil feed groove 54 through the first oil feed path 52. The hermetic compressor further includes an auxiliary oil feed path 57 which is provided in the eccentric part 41 of the rotating shaft 40 in the radial direction to communicate with the second oil feed path 56. Thus, the lubricating oil is fed from the second oil feed path 56 to the connecting rod 25 connected to the eccentric part 41.

As shown in FIG. 3, the second oil feed path 56 extends from the eccentric part 41 of the rotating shaft 40 to a predetermined position of an interior of the rotating shaft 40 under the thrust bearing 43. In other words, the second communication hole 55, which allows the second oil feed path 56 to communicate with the spiral oil feed groove 54, is provided at the position under the thrust bearing 43. When the upper end of the spiral oil feed groove 54 provided around the outer surface of the rotating shaft 40 is terminated at a position aligned with the thrust bearing 43, the lubricating oil which has reached the upper end of the spiral oil feed prove 54 cannot flow upward, but is undesirably dispersed to an outside in the radial direction through gaps of the thrust bearing 43. Thus, the second communication hole 55 is provided on the rotating shaft 40

at the position under the thrust bearing 43.

The hermetic compressor of the present invention further includes an oil guide part 58 which is provided on the outer surface of the rotating shaft 40 so that the oil guide part 58 extends from the upper end of the spiral oil feed groove 54 to the position of the thrust bearing, thus feeding the lubricating oil from the upper end of the spiral oil feed groove 54 to the thrust bearing 43 to lubricate and cool the thrust bearing 43. The oil guide part 58 is defined by a flat surface which is provided on the outer surface of the rotating shaft 40 in an axial direction, as shown in FIG. 4. Thus, the oil guide part 58 provides an oil passage between the outer surface of the rotating shaft 40 and the inner surface of the shaft support part 13 of the frame 12.

The operation and effect of the hermetic compressor will be described herein below.

When the rotating shaft 40 rotates by the operation of the drive unit 30 provided in the lower portion of the frame 12, as shown in FIG. 1, the rotating motion of the rotating shaft 40 is converted into the rectilinear reciprocating motion of the piston 23 by the connecting rod 25 of the compression unit 20, so that the piston 23 rectilinearly reciprocates in the compression chamber of the cylinder block 21. Due to the rectilinear reciprocating motion of the piston 23, the refrigerant is drawn into the compression chamber of the cylinder block 21 to be compressed, prior to being discharged from the compression chamber.

During the above-mentioned operation, the lubricating oil is lifted upward along the rotating shaft 40 from the bottom of the hermetic casing 10 to the plurality of drive parts by an operation of the oil feed unit, the lubricating

and cooling the drive parts and allows for a smooth operation of the hermetic compressor. The operation of the oil feed unit in the above state will be described in more detail herein below.

When the first oil pickup unit 51 rotates along with the rotating shaft 40, the lubricating oil on the bottom of the hermetic casing 10 is introduced into the first oil pickup unit 51 through the oil inlet 51c, and is fed upward to the first oil feed path 52 by the operation of the spiral blade 51b provided in the first oil pickup unit 51.

In the above state, the first oil feed path 52 is eccentric from the central axis of the rotating shaft 40, and is inclined in the rotating shaft 40 so that the central axis of the first oil feed path 52 is diverged from the central axis of the rotating shaft 40 at the angle θ_1. Furthermore, the second oil pickup unit 53 is provided in the first oil feed path 52. Therefore, even when the rotating shaft 40 rotates at a low speed, the oil lift force in the first oil feed path 52 is increased, thus the oil is efficiently fed to the spiral oil feed groove 54 through the first oil feed path 52. In the above state, the first communication hole 52a which is provided on the rotating shaft 40 at the position aligned with the upper end of the first oil feed path 52, feeds the oil from the first oil feed path 52 to the spiral oil feed groove 54.

Once the oil is introduced to the spiral oil feed groove 54, the oil flows upward by the operation of the spiral oil feed groove 54 while lubricating and cooling the junction between the outer surface of the rotating shaft 40 and the inner surface of the shaft support part 13 of the frame 12. Thus, the oil reaches the upper end of the spiral oil feed groove 54 and, thereafter, the oil is fed from the spiral oil feed groove 54 to the second oil feed

path 56 through the second communication hole 55 of the rotating shaft 40. The oil is, thereafter, fed from the second oil feed path 56 to a plurality of drive parts of the compression unit 20. In the above state, the second oil feed path 56 is inclined in the eccentric part 41 relative to the central axis of the rotating shaft 40 at the angle θ_2. Therefore, even when the rotating shaft 40 rotates at a low speed, the oil lift force in the second oil feed path 56 is increased, thus the oil is efficiently fed to the compression unit 20. Furthermore, in the above state, because the oil is fed from the upper end of the spiral oil feed groove 54 to the thrust bearing 43 through the oil guide part 58, the thrust bearing 43 is efficiently lubricated and cooled.

As apparent from the above description, the present invention provides a hermetic compressor, in which a first oil feed path is provided in a rotating shaft while being eccentric from a central axis of the rotating shaft and being diverged from the rotating shaft in an upward direction, with a second oil pickup unit provided in the first oil feed path. Therefore, even when the rotating shaft rotates at a low speed, an oil lift force in the first oil feed path is increased, thus lubricating oil is efficiently fed upward along the rotating shaft.

Furthermore, a second oil feed path is provided in an upper portion of the rotating shaft of the hermetic compressor while being diverged from the rotating shaft in the upward direction. Therefore, even when the rotating shaft rotates at a low speed, an oil lift force in the second oil feed path is increased, thus the lubricating oil is efficiently fed to a plurality of drive parts of a compression unit.

Furthermore, because the lubricating oil is fed to a

thrust bearing through an oil guide part provided on the upper portion of the rotating shaft, the thrust bearing is efficiently lubricated and cooled.

Although a preferred embodiment of the present invention has been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.